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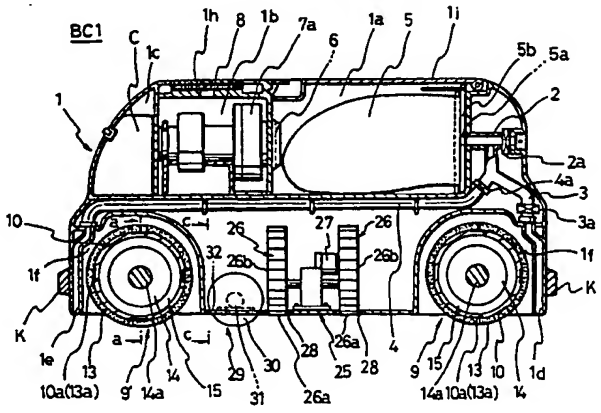

(57) Abstract: A self-driven automatic cleaner, designed to be movable in every direction on a floor under its own power while performing a wet-wiping operation and/or a vacuum-cleaning operation, is disclosed. In the primary embodiment, the cleaner is designed to move on the floor forward or backward by two forward-backward moving units (9, 9') while performing both the wet-wiping operation and the vacuum-cleaning operation. In this cleaner, each of the two forward-backward moving units (9, 9') is provided with a roller (10) having a damp cloth (9), thus performing the wet-wiping operation while moving the cleaner forward or backward. A lateral moving unit (25) is included in the cleaner, thus selectively moving the cleaner laterally on the floor when the cleaner collides against a hindrance and is stopped. The cleaner only performs a vacuum-cleaning operation during such a lateral movement. In the second embodiment, the cleaner (1) is free from the parts for performing a vacuum-cleaning operation, but is designed to automatically perform only the wet-wiping operation. In the third embodiment, the two forward-backward moving units are free from the damp cloth (9), and so the cleaner of the third embodiment only performs the vacuum-cleaning operation. The cleaner of this invention is also designed to be selectively operated in a self-driven mode or in a manual operational mode.

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SELF-DRIVEN AUTOMATIC CLEANER

Technical Field

The present invention relates, in general, to cleaners and, more particularly, to a self-driven automatic cleaner designed to be movable in every direction on a floor under its own power while performing a wet-wiping operation and/or a vacuum-cleaning operation.

Background Art

As well known to those skilled in the art, conventional cleaners for floors have been typically classified into three types: vacuum cleaners designed to clean the floor by sucking dirt along with suction air into a vacuum cleaner filter through a suction head, wet cleaners designed to clean the floor by wiping with a damp cloth, and wet/vacuum cleaners designed to have the wet-wiping effect expected from such wet cleaners and the vacuum-cleaning effect expected from the vacuum cleaners.

In the prior art, a self-driven automatic vacuum cleaner, designed to clean the floor while moving on the floor under its own power, has been proposed. Such a conventional self-driven automatic vacuum cleaner moves on the floor under its own power while sensing hindrances on the floor using sonic or radio sensors, and so it may often fail to be desirably operated within a room having a complex interior. In addition, since a technique of allowing the cleaner to move freely and effectively in every direction on the floor under its own power during a cleaning operation has not been proposed, such an automatic vacuum cleaner fails to be generalized.

The conventional wet cleaner, proposed and used recently, is designed to have a damp cloth on a holding plate, with a stick handle being coupled to the holding plate, and to wipe and wash the floor with the damp cloth when the holding plate is moved in every direction on the floor by a user handling the stick handle. However, the movement of the holding plate has to be manually

performed by a user, and so such a conventional wet cleaner is inconvenient to the user and wastes time during a cleaning operation, particularly, within a large room.

On the other hand, the conventional wet/vacuum cleaners, designed to perform both a wet-wiping operation and a vacuum-cleaning operation, have a damp cloth fixed to the suction head of a conventionally designed vacuum cleaner, with the suction head being connected to the suction port of the cleaner using both a stick handle and a flexible connection hose. The wet/vacuum cleaner wipes and cleans the floor with the wet-wiping effect and the vacuum-cleaning effect when the suction head with the damp cloth is moved in every direction on the floor by a user handling the stick handle. However, the movement of the suction head has to be manually performed by a user, and so such a conventional wet/vacuum cleaner is inconvenient to the user and wastes time during a cleaning operation, particularly, within a large room in the same manner as that described for the conventional wet cleaners.

Disclosure of the Invention

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a self-driven automatic cleaner, which is designed to be movable in every direction on the floor under its own power while performing a wet-wiping operation and/or a vacuum-cleaning operation.

In order to accomplish the above object, the present invention provides a self-driven automatic cleaner, comprising a main motor used for sucking air, laden with dirt, into a housing so as to allow the air to be filtered by a vacuum cleaner filter prior to being discharged into the atmosphere, further comprising: first and second suction holes formed upwardly from a bottom wall of the housing at positions inside both end walls of the housing, respectively, and commonly communicating with the vacuum cleaner filter, thus performing a vacuum-

cleaning operation; first and second forward-backward moving units installed at positions around the first and second suction holes, respectively, the forward-backward moving units adapted for performing a wet-wiping operation while moving the cleaner on a floor forward or backward; a lateral moving unit installed at an intermediate position between the forward-backward moving units and adapted for moving the cleaner on the floor laterally; and a forward-backward movement sensing unit installed at a position around the lateral moving unit and adapted for sensing a forward-backward movement of the cleaner, whereby when the cleaner collides against a hindrance and is stopped during a forward or backward movement on the floor, the sensing unit senses the stopping of the cleaner and makes the first and second forward-backward moving units operated in an inverse direction for a predetermined time, thus withdrawing the cleaner from the hindrance by a predetermined distance, the cleaner is, thereafter, moved laterally on the floor by a predetermined distance by the lateral moving unit with the first and second forward-backward moving units being stopped, and the forward-backward moving units are, thereafter, operated to move the cleaner on the floor forward or backward.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view of a self-driven automatic cleaner in accordance with the primary embodiment of the present invention;

Fig. 2 is a longitudinal sectioned view of the cleaner of Fig. 1;

Fig. 3 is a sectional view taken along the line a-a of Fig. 2, showing the construction of a forward-backward moving unit included in the automatic cleaner;

Fig. 4 is an exploded perspective view of the

forward-backward moving unit of Fig. 3;

Fig. 5 is a sectional view, showing the construction of the portion "A" of Fig. 3 in detail;

Fig. 6a is a sectional view taken along the line c-c of Fig. 2, showing the construction of a lateral moving unit included in the automatic cleaner;

Fig. 6b is a view corresponding to Fig. 6a, but showing an operation of the lateral moving unit when the cleaner is moved laterally;

Fig. 7 is a schematic plan view, showing an operation of the cleaner according to the primary embodiment when the cleaner performs both a wet-wiping operation and a vacuum-cleaning operation;

Fig. 8 is a perspective view, showing the cleaner according to the primary embodiment, which is in a manual operational mode with the suction head being connected to the suction port of the cleaner through both a flexible connection hose and a stick handle;

Fig. 9 is a perspective view of a self-driven automatic cleaner in accordance with the second embodiment of the present invention;

Fig. 10 is a longitudinal sectioned view of the automatic cleaner of Fig. 9;

Fig. 11 is a longitudinal sectioned view of a self-driven automatic cleaner in accordance with the third embodiment of the present invention;

Fig. 12 is a perspective view, showing a lifting unit included in the automatic cleaner of Fig. 11;

Fig. 13a is a sectional view taken along the line d-d of Fig. 11, showing the construction of both the lateral moving unit and the lifting unit of the cleaner;

Fig. 13b is a view corresponding to Fig. 13a, but showing an operation of both the lateral moving unit and the lifting unit of the cleaner;

Fig. 14 is an exploded perspective view, showing a lateral moving unit in accordance with a modification of the preferred embodiments of this invention;

Fig. 15a is a sectional view of the lateral moving unit of Fig. 14;

Fig. 15b is a view corresponding to Fig. 15a, but

showing an operation of the lateral moving unit; and

Fig. 16 is a schematic plan view, showing an operation of the cleaner, with the lateral moving unit of Fig. 14, when the cleaner is moved laterally on a floor by the lateral moving unit.

Best Mode for Carrying Out the Invention

Fig. 1 is a perspective view of a self-driven automatic cleaner in accordance with the primary embodiment of the present invention. Fig. 2 is a longitudinal sectioned view of the above cleaner.

As shown in the drawings, the cleaner BC1 of this invention comprises a housing 1 having a box shape. The upper portion of the interior of the housing 1 is partitioned into a plurality of chambers, a cleaner filter chamber 1a, a main motor chamber 1b, and a controller chamber 1c. A suction hole 1d, 1e is formed upwardly at each end wall of the housing 1, with a roller chamber 1f being formed in the lower portion of the interior of the housing 1 at a position just around each suction hole 1d, 1e and seating one forward-backward moving unit 9, 9' therein. The above unit 9, 9' will be described later herein in detail. A locking hole 1g is formed on each sidewall of each roller chamber 1f so as to hold the unit 9, 9' to the sidewalls as shown in Fig. 1. An air exhaust grill 1h is provided on the top wall of the housing 1 above the main motor chamber 1b. The top of the cleaner filter chamber 1a is covered with an openable lid 1i.

A suction port 2, provided with a first valve 2a, is formed around the cleaner filter chamber 1a. The suction port 2 is connected to the two suction holes 1d and 1e through two suction hoses 3, 4, with a second valve 3a set on the first hose 3 and the third valve 3b set on the second hose 4.

A vacuum cleaner filter 5 is removably set in the filter chamber 1a with the suction mouth 5a of the filter 5 being held by a filter locking plate 5b. In such a case, the suction mouth 5a of the vacuum cleaner filter

5 communicates with the suction port 2 of the housing 1.

A motor protection filter 6 is set in an area between the cleaner filter chamber 1a and the motor chamber 1b within the housing 1 so as to filter air flowing from the filter chamber 1a to the motor chamber 1b. A main motor 7, provided with a suction fan 7a, is set in the motor chamber 1b. An electromagnetic filter 8 is set in an area under the grill 1h above the motor chamber 1b so as to filter air from the motor chamber 1b prior to exhausting the air into the atmosphere through the grill 1h.

In the drawings, the reference character C denotes a controller set in the controller chamber 1c, RL denotes an electric power supply cord, and K denotes a shock absorber exteriorly provided at each end wall of the housing 1 for protecting the housing 1 from impact energy when the cleaner BC1 collides against a hindrance at the end wall.

In order to clean the floor using the cleaner BC1, the main motor 7 is primarily turned on, thus rotating the suction fan 7a. There thus occurs a difference in the pressure between atmospheric air and internal air of the housing 1, and so the atmospheric air along with dirt is sucked into the housing 1 from the lower space under the first suction hole 1d through the hole 1d. Within the housing 1, the sucked air passes through the hose 3, the suction port 2, the cleaner filter chamber 1a, the motor chamber 1b prior to being discharged from the housing 1 into the atmosphere through the exhaust grill 1h. When the air passes through the housing 1 as described above, dirt, laden in the air, is primarily filtered off by the vacuum cleaner filter 5 within the filter chamber 1a. The air from the cleaner filter chamber 1a is, thereafter, subjected to a second filtering process by the motor protection filter 6 and to a third filtering process by the electromagnetic filter 8 prior to being discharged into the atmosphere from the exhaust grill 1h. The dirt, laden in the sucked air, is thus almost completely filtered off and removed from the air before the air is exhausted into the atmosphere.

The roller chamber 1f, formed in the lower portion of the interior of the housing 1 at a position just around each suction hole 1d, 1e, seats one forward-backward moving unit 9, 9' therein. The objective of the above units 9 and 9' is to move the cleaner BC1 on the floor forward or backward. That is, the two units 9 and 9' move the cleaner BC1 in an axial direction of the housing 1 during a cleaning operation. The construction of the two units 9 and 9' is as follows.

The first and second units 9 and 9' have the same construction, and so the description for the construction of the two units 9 and 9' is limited to the first unit 9 for ease of description.

In Figs. 2 to 4, the reference numeral 10 denotes a hollow cylindrical roller which is set in each roller chamber 1f of the housing 1. A plurality of first locking strips 10a, such as Velcro strips with small hooks, are axially mounted along the external surface of the roller 10 while being regularly spaced apart from and parallel to each other. Both ends of the roller 10 are individually sided by a holding cap 11, 12.

A damp cloth 13 is firmly wound around the roller 10. In such a case, a plurality of second locking strips 13a, such as rough Velcro strips, are mounted on the cloth 13 at positions corresponding to the first locking strips 10a and are stuck to the first locking strips 10a by being pressed, thus attaching the damp cloth 13 to the external surface of the roller 10. A roller motor 14 is installed within the roller 10, with a motor-operated rotor drum 15 being integrated with the interior surface of the roller 10 at its external surface. In the present invention, the motor 14 for each unit 9, 9' is selected from a reversible motor designed to be rotated at a high speed or at a lower speed as desired. Of course, the two motors 14 of the two units 9 and 9' are rotated in the same direction during a movement of the cleaner BC1. In the present invention, it is preferable to set the rotating speed ratio between the two motors 14 during a movement of the cleaner BC1 on the floor to 3 : 1.

The first holding cap 11 rotatably engages with a

first motor support shaft 14a, which supports the motor 14 within the roller 10 and is used as a power connection means for supplying electric power to the motor 14. On the other hand, the second holding cap 12 rotatably engages with a second motor support shaft 16. A slide surface 14b, 16a, formed on one end of each motor support shaft 14a, 16, is always brought into surface contact and vertically slidable engagement with the guide hole 17a, 18a of a guide cap 17, 18.

A spring 19, 20 is set between each guide hole 17a, 18a and an associated motor support shaft 14a, 16 so as to normally bias the motor support shaft 14a, 16 downwardly.

A locking surface 17b, 18b is formed on the external surface of each guide cap 17, 18. When the guide caps 17 and 18 are locked to the locking holes 1g formed on the sidewalls 1k and 1m of the housing 1, the locking surface 17b, 18b of each guide cap 17, 18 is inserted into the locking hole 1g formed on the sidewall 1k, 1m of the housing 1. The guide caps 17 and 18 are exteriorly projected from the locking holes 1g of the housing 1. The above guide caps 17 and 18 are also brought into engagement with locking caps 21 and 22 so as to be firmly locked to the locking holes 1g.

A guide hole 1j is formed on each of the sidewalls 1k and 1m of the housing 1 at a position above each locking hole 1g engaging with the guide cap 17, 18. An elastic contact pin 24, 24' is inserted into each guide hole 1j while being normally biased downwardly by a spring 23, 23'. The pin 24, 24' is thus brought into contact with the external surface of the locking cap 21 at its lower end. Connected to the elastic contact pins 24 and 24' are electric cords used for supplying electric power to the motor 14.

In the drawings, the reference characteristics T1 and T2 denote fixtures which lock the guide caps 17 and 18 to the motor support shafts 14a and 16. The fixtures T1 and T2 thus retain the engagement of the guide caps 17 and 18 with the shafts 14a and 16 when the first and second units 9 and 9' are removed from the locking holes 1g of

the housing 1.

When the motors 14 of the two units 9 and 9' are turned on, each rotor drum 15 of the units 9 and 9' is rotated. The rollers 10 of the units 9 and 9' are thus rotated along with the damp cloths 13. In such a case, the slide surfaces 14b and 16a of the motor support shafts 14a and 16 are brought into vertically movable engagement with the guide holes 17a and 18a, while the shafts 14a and 16 are also biased downwardly by the springs 19 and 20. The rollers 10 are thus elastically and vertically movable within a range limited by a predetermined height. That is, the first and second units 9 and 9' are designed to allow the rollers 10 to smoothly move on the floor without having any difficulty even though the floor is not even, but is uneven.

When the cleaner BC1 moves in a direction from the second unit 9' to the first unit 9 during a cleaning operation, the damp cloth 13 on the roller 10 of the first unit 9 is rotated at a high speed, while the damp cloth 13 on the roller 10 of the second unit 9' is rotated at a low speed. Therefore, the two damp cloths 9 and 9' effectively wipe the floor while rolling and dragging on the floor. The cleaner BC1 is thus moved on the floor in the desired direction. In a detailed description, since the damp cloth 13 of the first unit 9 is rotated at a high speed with the damp cloth 13 of the second unit 9' being rotated at a low speed, the first damp cloth 13 moves forward on the floor while dragging backward due to the relatively high rotating speed thereof. The first damp cloth 13 thus effectively wipes the floor. On the other hand, the second damp cloth 13 moves forward on the floor while dragging forward due to the relatively low rotating speed thereof. The second damp cloth 13 thus effectively wipes the floor. During a cleaning operation of the cleaner, such a movement of the cleaner, performed by the two units 9 and 9', is controlled by the controller C.

The housing 1 of the cleaner BC1 also includes a lateral moving unit 25 on the bottom wall at a position between the first and second units 9 and 9' and near one

sidewall 1k of the housing 1. The lateral moving unit 25 moves the cleaner BC1 on the floor laterally as desired during a cleaning operation of the cleaner BC1.

The above lateral moving unit 25 comprises two traveling rollers 26 which individually have a flat portion 26a on its circumferential surface. The two traveling rollers 26 are commonly rotated by a motor 27. In the lateral moving unit 25, the two traveling rollers 26 are positioned in parallel to the lateral axis of the housing 1 at an intermediate position between the two forward-backward moving units 9 and 9'. Two roller seat openings 28 are formed on the bottom wall of the housing 1, thus allowing the rounded portions 26c of the rollers 26 to be selectively positioned within the openings 28 when the rollers 26 are rotated to move the cleaner BC1 laterally. When the motor 27 is started to rotate the rollers 26 and lets the rounded portions 26c of the rollers 26 positioned within the openings 28 at the same time, one side of the cleaner BC1 is raised up and supported by the rollers 26 as shown in Fig. 6b.

That is, when the traveling rollers 26 are rotated by the motor 27 as described above, the rounded portions 26c of the rollers 26 are projected from the bottom wall of the housing 1 through the openings 28 so as to come into contact with the floor. In such a case, a side of the cleaner BC1 is raised up and supported by the roller 26 as shown in Fig. 6b, with the two damp cloths 13 rolling and dragging on the floor while supporting the other side of the cleaner BC1 at one end thereof. The cleaner BC1 thus moves on the floor laterally by a predetermined distance.

In the preferred embodiment of this invention, the length of the rounded portion 26c of the rollers 26 is set equal to the length of each damp cloth 13, thus allowing the cleaner BC1 to move on the floor laterally by a distance equal to the length of each damp cloth 13 during a one rotating action of the rollers 26.

A forward-backward movement sensor 29 is provided on the bottom wall of the housing 1 at a position around the lateral moving unit 25 and is used for sensing a forward-

backward movement of the cleaner BC1.

In the preferred embodiment, an encoder is used as the forward-backward movement sensor 29. The encoder comprises a roller 30 and an encoder body 31 sensing a rotating action of the roller 30. The roller 30 of the encoder is positioned within a roller seat opening 32 longitudinally formed on the bottom wall of the housing 1, and is projected downwardly through the opening 32 so as to be always brought into contact with the floor.

During a forward-backward movement of the cleaner BC1 on the floor, the sensor 29 senses a rotating action of the roller 30 and transmits a signal, indicative of the rotating action of the roller 30, to the controller C through the encoder body 31, thus allowing the controller C to be informed of the cleaner BC1 moving on the floor without being stopped. However, when the cleaner BC1 is unexpectedly stopped by a hindrance H on the floor during a movement, a signal indicative of a stopping of the roller 30 is transmitted from the sensor 29 to the controller C through the encoder body 31. The controller C is thus informed of the cleaner BC1 stopped on the floor.

The cleaner BC1 of this invention automatically performs a wet-wiping operation in addition to a vacuum-cleaning operation while moving on the floor under its own power as follows.

In order to perform a cleaning operation of the cleaner BC1 in a self-driven mode, the cleaner BC1 is laid on the floor prior to designating a desired moving direction of the cleaner BC1 by operating the controller C as shown in Fig. 7. In the following description, the primary moving direction of the cleaner BC1 is set to a direction from the second unit 9' to the first unit 9. After designation of the desired moving direction, an automatic mode is selected. The main motor 7, the forward-backward moving units 9 and 9', and the motors 14 are operated. In such a case, the second valve 3a of the hose 3 is opened, with both the first valve 2a of the suction port 2 and the third valve 4a of the hose 4 being closed.

When the cleaner BC1 is started as described above, the motor 14 of the first unit 9 is rotated at a high speed, while the motor 14 of the second unit 9' is rotated at a low speed. The damp cloths 13, wound around the rollers 10 of the two units 9 and 9', perform a wet-wiping action while rolling and dragging on the floor so as to move the cleaner BC1 on the floor in a direction as shown by the arrow R of Fig. 7. During such a movement in addition to the wet-wiping action, air along with dirt is sucked from the floor into the housing 1 through the first suction hole 1d. That is, the cleaner BC1 performs a vacuum-cleaning operation in addition to the wet-wiping operation.

During such a movement of the cleaner BC1 on the floor, the sensor 29 senses a rotating action of the roller 30 and transmits a signal to the controller C through the encoder body 31, thus allowing the controller C to be informed of the cleaner BC1 moving on the floor. When the cleaner BC1 is unexpectedly stopped by a hindrance H on the floor during a movement, a signal indicative of an unexpected stopping of the roller 30 is transmitted from the sensor 29 to the controller C through the encoder body 31, thus allowing the controller C to be informed of the cleaner BC1 stopped on the floor.

When the controller C is informed of the cleaner BC1 stopped on the floor, both motors 14 of the two units 9 and 9' start to be rotated in an inverse direction under the control of the controller C. The cleaner BC1 is moved backward from the hindrance H. In such a case, the motor 14 of the first unit 9 is rotated at a low speed, while the motor 14 of the second unit 9' is rotated at a high speed. In addition, the third valve 4a is opened, with the first and second valves 2a and 3a being closed.

During the backward moving operation, the motors 14 of the two units 9 and 9' are continuously operated for a preset time, about 3 seconds, prior to being stopped. That is, the cleaner BC1 withdraws from the hindrance H to a predetermined distance D and is stopped temporarily.

When the cleaner BC1 is stopped after the withdrawal from the hindrance H, the motor 27 of the lateral moving

unit 25 is started to rotate the traveling roller 26 one turn, and so the cleaner BC1 moves on the floor laterally by a distance B of Fig. 7, the distance B being equal to the length of the damp cloth 13, prior to being stopped. Thereafter, the two motors 14 of the two forward-backward moving units 9 and 9' are rotated to move the cleaner BC1 in the same manner as that described above. Thereafter, the cleaner BC1 moves in a direction as shown by the arrow L of Fig. 7. There thus occurs a difference in the pressure between atmospheric air and internal air of the housing 1, and so the atmospheric air along with dirt is sucked into the housing 1 from the lower space under the first suction hole 1e through the hole 1e. In the present invention, the cleaner BC1 is designed to allow air laden with dirt to be sucked into the housing 1 through only one of the two suction holes 1d and 1e during a movement of the cleaner in a direction. This forms a high suction pressure within the suction hose 3, thus resulting in a desired vacuum-cleaning effect.

The above operation of the cleaner BC1 is continued until the cleaner completely travels all over the total area of the floor. Therefore, the cleaner of this invention automatically wet-wipes and vacuum-cleans the floor while moving on the floor under its own power.

In the operation of the cleaner BC1, the motors 14 and 27 and the valves 2a, 3a and 4a are sequentially controlled by the controller C.

The cleaner BC1 of this invention may be used in a manual operational mode in place of the above-mentioned self-driven mode as desired. In order to perform a vacuum cleaning operation of the cleaner BC1 in such a manual mode, the stick handle of a flexible connection hose 34, assembled with a suction head 33, is fitted into the suction port 2 of the cleaner BC1 as shown in Fig. 8. When such a manual mode is selected, the first valve 2a is opened, with both the second valve 2a and the third valve 4a being closed. In addition, neither motor 14 is turned on, but is retained at a neutral position, and so the two units 9 and 9' are not operated. The cleaner BC1 in such a manual mode is operated in the same manner as

that of conventional vacuum cleaners.

Fig. 9 is a perspective view of a self-driven automatic cleaner in accordance with the second embodiment of the present invention. Fig. 10 is a longitudinal sectioned view of the cleaner of Fig. 9.

In the second embodiment, the cleaner BC2 is free from the parts for performing a vacuum-cleaning operation, but is designed to automatically perform only a wet-wiping operation. Therefore, it is not necessary to form a space for the vacuum cleaning parts in the housing 1' of the second embodiment.

The cleaner BC2 according to the second embodiment is, particularly, designed to perform the same wet-wiping operation as that described for the primary embodiment. The cleaner BC2 has a simple construction and is inexpensive in comparison with the cleaner BC1, and so it may be effectively used by a user who has a separate vacuum cleaner.

Fig. 11 is a longitudinal sectioned view of a self-driven automatic cleaner in accordance with the third embodiment of this invention.

In the cleaner BC3 according to the third embodiment, the two forward-backward moving units 40 are free from a wet-wiping means different from the cleaner BC1 of the primary embodiment. That is, the two units 40 are, particularly, designed to move the cleaner forward or backward with the cleaner only performing a vacuum-cleaning operation. The cleaner BC3 also has a lifting unit 44 which supports the side of the cleaner at a position opposite to the lateral moving unit 25. The cleaner BC3 thus smoothly moves laterally on the floor during a vacuum-cleaning operation. Since the two units 40 of the cleaner BC3 are free from the wet-wiping means, it is not necessary to form an isolated chamber 1f for the wet wiping means in the housing 1" of the cleaner BC3.

In the third embodiment, the two forward-backward

drive motor 43. The two driven rollers 41 are rotatably held by the sidewalls 1k and 1m of the housing 1" at a position inside the first suction hole 1d so as to be rotatable in an axial direction of the housing 1". The two drive rollers 42, mounted to both ends of a drive shaft 42a, are rotatably held by the sidewalls 1k and 1m at a position inside the second suction hole 1e so as to be rotatable in the axial direction of the housing 1". The motor 43 supplies a rotating force to the drive rollers 42.

When the motor 43 is rotated in either direction, the rotating force of the motor 43 is transmitted to the drive rollers 42, thus moving the cleaner BC3 on the floor forward or backward with the cleaner performing a vacuum-cleaning operation.

As shown in Fig. 12, the lifting unit 44 of the cleaner BC3 comprises two spaced brackets 45 and 46 formed on the sidewall 1m of the housing 1" at a position opposite to the lateral moving unit 25. A support shaft 47 is rotatably held by the two brackets 45 and 46, with three links 48, 49 and 50 being commonly held by the support shaft 47 at spaced positions. A roller shaft 51 rotatably engages with the three links 48, 49 and 50 and extends in parallel to the support shaft 47. Two liftable rollers 54 and 55 are held on both ends of the roller shaft 51 and are positioned to be seated within two roller seat openings 52 and 53, formed on the bottom wall of the housing 1", during an operation of the unit 44. A motor 56 is fixedly mounted to the sidewall 1m at a position above the support shaft 47. A lift link motion, comprising two jointed link bars 57 and 58, connects the output shaft of the motor 56 to the roller shaft 51, with the rotatable link bar 57 jointed to the output shaft of the motor 56 and the liftable link bar 58 jointed to the roller shaft 51. In the third embodiment, the two liftable rollers 54 and 55 are positioned to be symmetric to the two traveling rollers 26 of the lateral moving unit 25.

In an operation of the lifting unit 44, the reversible motor 56 rotates the rotatable link bar 57 at

an angle in either direction, thus causing the liftable rollers 54 and 55 to move down or up through the two openings 52 and 53. When the rollers 54 and 55 move down through the two openings 52 and 53 so as to achieve a fully lowered position, they rotatably support the cleaner BC3 at a position opposite to the lateral moving unit 25 as shown in Fig. 13b. When the cleaner BC3 moves forward or backward, the two rollers 54 and 55 are retained at a fully raised position as shown in Fig. 13a, thus being free from causing any interference with the floor during the forward or backward movement of the cleaner BC3. When it is necessary to move the cleaner BC3 laterally, the motor 27 is started to rotate the traveling rollers 26 of the lateral moving unit 25, while the motor 56 is started to move the two liftable rollers 54 and 55 downwardly. Therefore, both sides of the cleaner BC3 are supported by the four rollers 26, 54 and 55, thus allowing the cleaner BC3 to smoothly move on the floor laterally.

In an operation of the cleaner BC3 according to the third embodiment, the motor 43 of the forward-backward moving unit 40 is started in the same manner as that described for the motors 14 of the two units 9 and 9' of the primary embodiment. The cleaner BC3 thus moves on the floor forward or backward. When the motor 56 of the lifting unit 44 is started simultaneously with the start of the motor 27 of the lateral moving unit 25, the cleaner BC3 smoothly moves on the floor laterally. During such a movement of the cleaner BC3 on the floor, the atmospheric air, laden with dirt, is sucked into the housing 1" through either suction hole 1d or 1e in the same manner as that described for the primary embodiment. The cleaner BC3 thus automatically performs an effective vacuum-cleaning operation while moving on the floor under its own power.

In addition, the cleaner BC3 may perform a vacuum-cleaning operation in a manual operational mode in place of the above-mentioned self-driven mode when necessary. In such a manual mode, the stick handle of a flexible connection hose 34, assembled with a suction head 33, is

fitted into the suction port 2 of the cleaner BC3 in the same manner as that described for the primary embodiment.

Of course, it should be understood that the lateral moving unit 25 of the three embodiments and the forward-backward moving units 9 and 9' of the first and second embodiments may be modified in order to improve the operational efficiency of the cleaner without affecting the functioning of this invention.

Fig. 14 is an exploded perspective view, showing a lateral moving unit in accordance with a modification of the three embodiments of this invention.

In this modification, the lateral moving unit 60 comprises a channeled guider 61 fixedly mounted to the sidewall 1k of the housing 1, with the channel of the guider 61 extending vertically. A gear box 62 slidably engages with the channel of the guider 61 in a way such that the box 62 is vertically movable under the guide of the guider 61. A roller drive motor 65 is set within the gear box 62, with two roller shafts 63 and 64 extending from the motor 65 in opposite directions so as to project from the gear box 62 and be rotated by the motor 65. Two traveling rollers 66 and 67, mounted to the outside ends of the roller shafts 63 and 64, are positioned to be seated within two roller seat openings 28, formed on the bottom wall of the housing 1, during an operation of the unit 60. A roller lift motor 68 is fixedly mounted to the sidewall 1k and generates a rotating force used for vertically moving the gear box 62 within the guider 61. The unit 60 also has an encoder 69 used for sensing a lateral movement of the cleaner. The encoder 69 comprises an encoder body 69a assembled with the gear box 62. A roller 69b is provided on the encoder body 69a. In order to operate the lateral moving unit 60, the motor 68 is started to move the rollers 66 and 67 down, thus allowing the rollers 66 and 67 to support the side of the cleaner BC1, BC2, BC3. In such a case, the roller 69b of the encoder 69 is brought into contact with the floor.

The lateral moving unit 60 is operated as follows. That is, in order to move the cleaner BC1, BC2, BC3 laterally on a floor, the two rollers 66 and 67 are

primarily lowered by the roller lift motor 68 before the rollers 66 and 67 are rotated by the drive motor 65 as shown in Fig. 15b. When the rollers 66 and 67 are rotated, the cleaner moves laterally on the floor by a distance equal to the width of the cleaner. After the lateral movement of the cleaner is accomplished, the roller lift motor 68 is rotated in an inverse direction with the roller drive motor 65 being stopped, thus raising the two rollers 66 and 67 so as to retract the rollers into the housing as shown in Fig. 15a. The fully retracted rollers 66 and 67 do not cause any interference with the floor during a forward or backward movement of the cleaner.

When the cleaner collides against a hindrance H and is unexpectedly stopped while moving laterally on a floor by the lateral moving unit 60 as shown in Fig. 16, a signal indicative of a stopping of the roller 69b is transmitted from the encoder body 69a to the controller C. Upon receiving the signal from the encoder 69, the controller C rotates the roller drive motor 65 in an inverse direction for a predetermined time (about 3 seconds), thus allowing the cleaner BC1. BC2, BC3 to be withdrawn from the hindrance H by a distance B. After a lateral movement of the cleaner, the rollers 66 and 67 are raised up by the roller lift motor 68, thus being free from any interference with the floor during a forward or backward movement of the cleaner.

In a brief description, the lateral moving unit 60 is designed to allow the cleaner BC1, BC2, BC3 to be movable to a position, at which the cleaner can start to move forward or backward, when the cleaner collides against a hindrance and is unexpectedly stopped during a lateral movement on a floor. Therefore, the lateral moving unit 60 allows the cleaner to move laterally on a floor more effectively in comparison with the above-mentioned unit 25.

Industrial Applicability

As described above, the present invention provides

a self-driven automatic cleaner designed to be movable in every direction on a floor under its own power while performing a wet-wiping operation and/or a vacuum-cleaning operation.

The cleaner according to the primary embodiment is designed to move on a floor forward or backward by two forward-backward moving units while performing a wet-wiping operation and a vacuum-cleaning operation. When this cleaner collides against a hindrance and is thus unexpectedly stopped during a forward or backward movement, the cleaner moves laterally by a lateral moving unit by a distance equal to the length of each damp cloth of the forward-backward moving units. During such a lateral movement on the floor, the cleaner continues the vacuum-cleaning operation. That is, the cleaner according to the primary embodiment is, particularly, designed to perform a wet-wiping operation and a vacuum-cleaning operation on an even floor while moving on the total area of floor under its own power. This cleaner is thus suitable for cleaning a floor needing to be wiped with damp cloths and to be vacuum-cleaned. In the primary embodiment, the two forward-backward moving units are designed to perform the wet-wiping operation, and so the construction of the cleaner is simplified. Such a simple construction reduces the production cost and improves the durability of the cleaner.

In the second embodiment, the cleaner is free from the parts for performing a vacuum-cleaning operation, but is designed to automatically perform only a wet-wiping operation. This cleaner has a simpler construction and further reduces the production cost, and so it may be effectively used by a user who has a separate vacuum cleaner.

In the cleaner according to the third embodiment, the two forward-backward moving units are free from a wet-wiping means different from the cleaner of the primary embodiment. That is, the two forward-backward moving units are, particularly, designed to move the cleaner forward or backward with the cleaner only performing a vacuum-cleaning operation. In this embodiment, the

cleaner is more smoothly movable laterally on the floor with both sides of the cleaner being supported by two rollers of a lifting unit and two rollers of a lateral moving unit. This cleaner performs a vacuum-cleaning operation while moving on the floor forward, backward or laterally under its own power. The cleaner according to the third embodiment is thus suitable for cleaning a floor needing to be vacuum-cleaned.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims:

1. A self-driven automatic cleaner, comprising a main motor used for sucking air, laden with dirt, into a housing so as to allow the air to be filtered by a vacuum cleaner filter prior to being discharged into the atmosphere, further comprising:

first and second suction holes formed upwardly from a bottom wall of the housing at positions inside both end walls of the housing, respectively, and commonly communicating with said vacuum cleaner filter, thus performing a vacuum-cleaning operation;

first and second forward-backward moving units installed at positions around said first and second suction holes, respectively, said forward-backward moving units adapted for performing a wet-wiping operation while moving the cleaner on a floor forward or backward;

a lateral moving unit installed at an intermediate position between said forward-backward moving units and adapted for moving the cleaner on the floor laterally; and

a forward-backward movement sensing unit installed at a position around the lateral moving unit and adapted for sensing a forward-backward movement of the cleaner,

whereby when the cleaner collides against a hindrance and is stopped during a forward or backward movement on the floor, the sensing unit senses the stopping of the cleaner and makes the first and second forward-backward moving units operated in an inverse direction for a predetermined time, thus withdrawing the cleaner from the hindrance by a predetermined distance, said cleaner is, thereafter, moved laterally on the floor by a predetermined distance by the lateral moving unit with the first and second forward-backward moving units being stopped, and said forward-backward moving units are, thereafter, operated to move the cleaner on the floor forward or backward.

2. The self-driven automatic cleaner according to claim 1, wherein each of said first and second forward-

backward moving units comprises:

a cylindrical roller transversely set in a lower portion of the housing and rotatably held by both sidewalls of the housing at both ends thereof; and

a motor generating a rotating force for said roller;

a damp cloth removably wound around said roller,

whereby the motor of a leading-side unit is rotated at a high speed and the motor of a trailed-side unit is rotated at a low speed, thus allowing the damp cloths of the two units to perform the wet-wiping operation while rolling and dragging on the floor so as to move the cleaner forward or backward.

3. The self-driven automatic cleaner according to claim 1, wherein said lateral moving unit comprises:

two traveling rollers installed at a position near a sidewall of the housing while being in parallel to a lateral axis of the housing, said traveling rollers individually having a flat portion on their circumferential surfaces; and

a motor generating a rotating force for the two traveling rollers,

whereby said motor rotates the two traveling rollers, thus allowing the two traveling rollers to move the cleaner laterally on the floor while supporting a side of the cleaner upwardly by their rounded portions.

4. The self-driven automatic cleaner according to claim 1, wherein said forward-backward movement sensing unit comprises:

a roller rotated while being brought into contact with the floor during a forward-backward movement of the cleaner on the floor; and

an encoder body adapted for sensing a rotating action of said roller.

5. The self-driven automatic cleaner according to claim 1, further comprising:

a suction port formed in the housing, with both ends of the port communicating with the vacuum cleaner filter

and the atmosphere; and

first and second suction hoses connecting the first and second suction holes to the suction port, respectively; and

first to third valves provided on the suction port and the suction hoses, respectively,

whereby both the first valve and one of the second and third valves are opened during a self-driven mode of the cleaner, thus sucking the air laden with dirt into the housing through a leading-side suction hole, while only the first valve is opened during a manual operational mode of the cleaner, with the second and third valves being closed and a suction head being coupled to the suction port through a connection hose.

6. The self-driven automatic cleaner according to claim 1, wherein

each of said first and second forward-backward moving units comprises:

two driven rollers rotatably held by the sidewalls of the housing at a position around the first suction hole so as to be rotatable in an axial direction of the housing;

two drive rollers mounted to both ends of a drive shaft and rotatably held by the sidewalls of the housing at a position around the second suction hole so as to be rotatable in the axial direction of the housing; and

a motor supplying a rotating force to said drive rollers;

said lateral moving unit is installed at a position around a first sidewall of the housing; and

a lifting unit is installed at a position around a second sidewall of the housing opposite to said lateral moving unit, said lifting unit comprising two spaced liftable and motor-operated rollers provided at a position around the second sidewall,

whereby said first and second forward-backward moving units are operated by the motors during a forward-backward movement of the cleaner on the floor, and both the

lateral moving unit and the lifting unit support both sides of the housing during a lateral movement of the cleaner on the floor, and said cleaner only performs a vacuum-cleaning operation during the forward-backward movement and the lateral movement.

7. The self-driven automatic cleaner according to claim 1, wherein said lateral moving unit comprises:

two traveling rollers installed in the housing while being rotatable by a roller drive motor and being movable up or down by a roller lift motor; and

an encoder installed to be movable up or down along with the two traveling rollers and adapted for sensing a lateral movement of the cleaner on the floor,

whereby said traveling rollers are moved down by the roller lift motor and are rotated by the roller drive motor, thus moving the cleaner laterally on the floor with a roller of said encoder being rotated while coming into contact with the floor during the lateral movement of the cleaner, thus sensing the lateral movement.

8. The self-driven automatic cleaner according to claim 1, wherein said housing is free from the parts for the vacuum-cleaning operation, thus allowing the cleaner to exclusively perform the wet-wiping operation.

9. The self-driven automatic cleaner according to claim 2, wherein the ratio of the rotating speed between the motor of said leading-side unit and the motor of said trailed-side unit is set to 3 : 1.

Fig.1

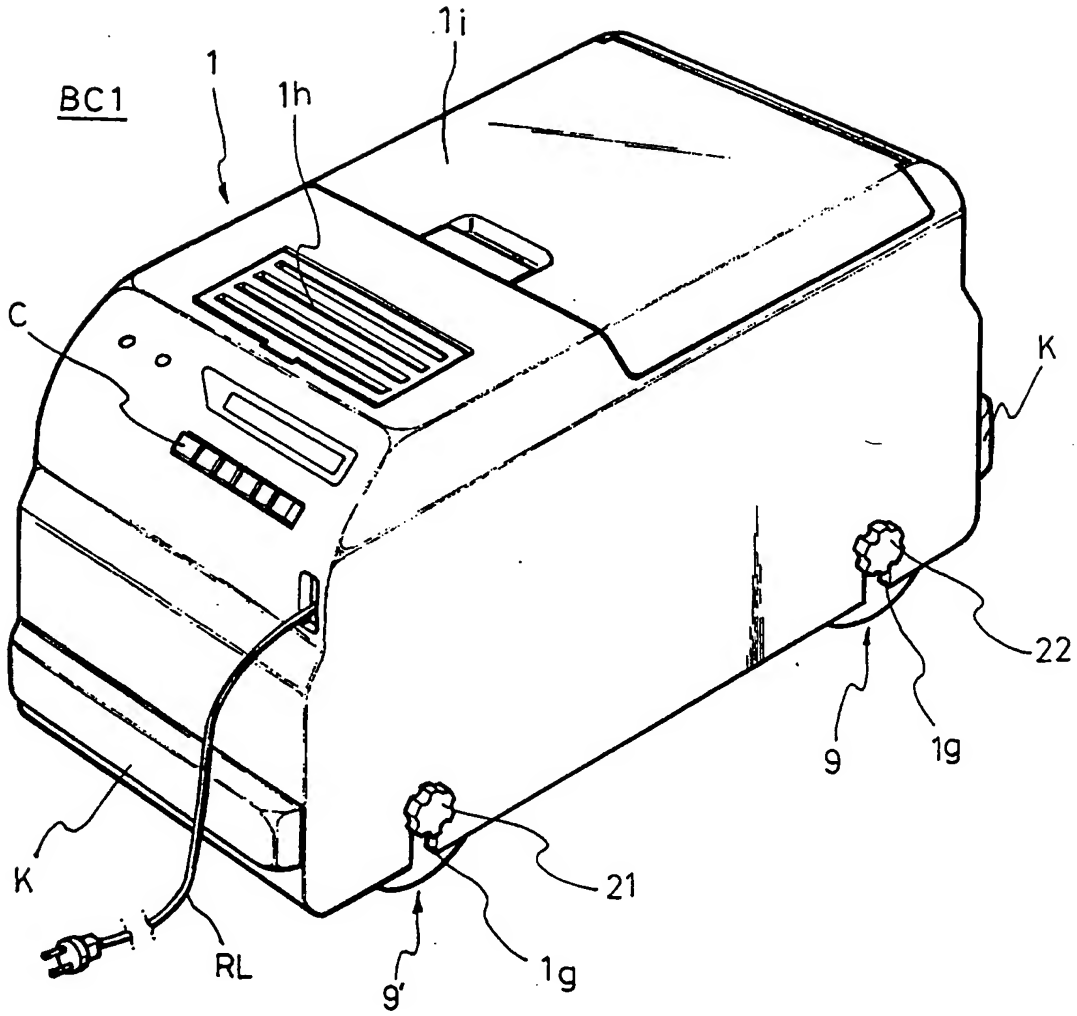
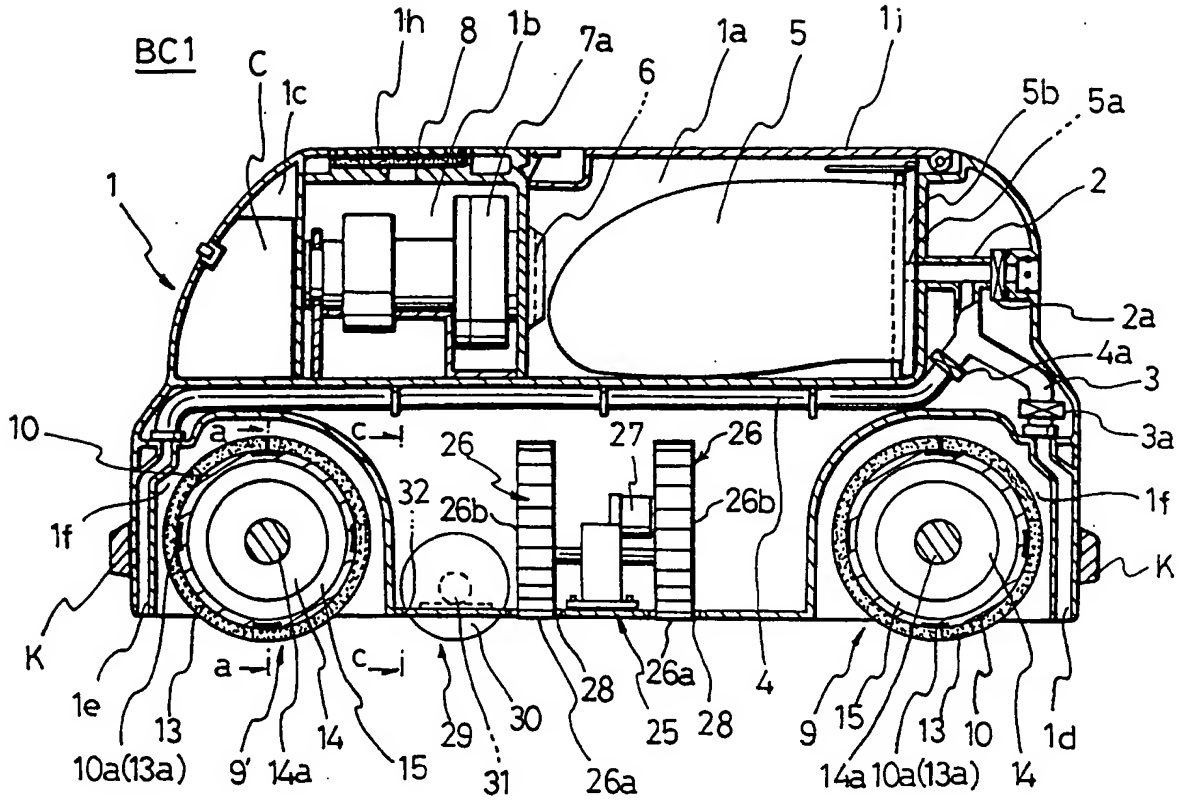


Fig.2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C
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1h
8
1b
7a
6
1a
5
1j
5b
5a
1
2
2a
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3a
10
a
c
26
27
26
32
26b
26b
1f
1f
K
K
a
c
1e
13
14
15
29
30
28
26a
25
28
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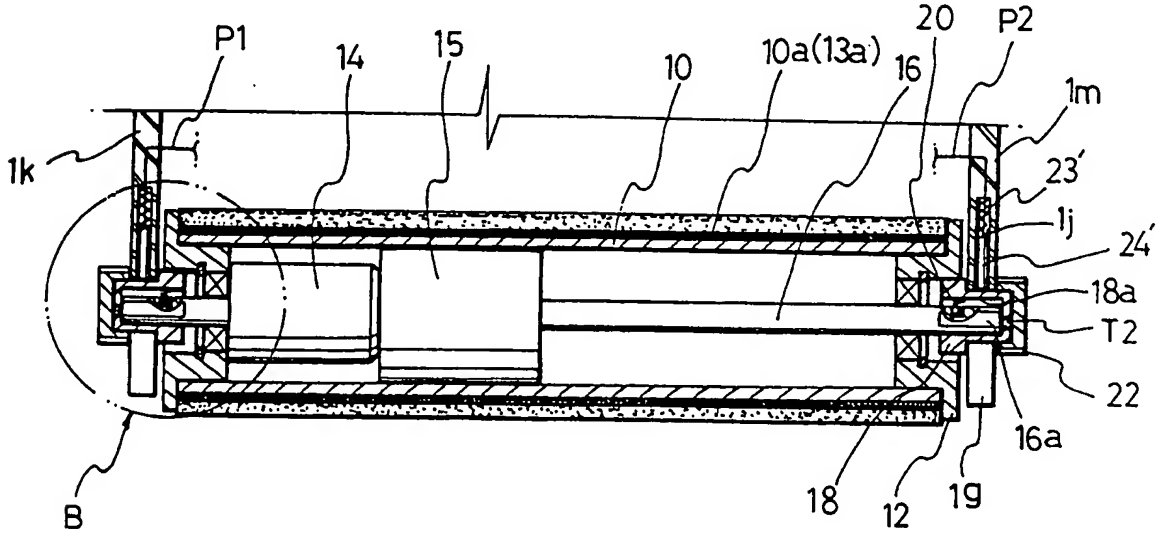
31
26a
14a
10a(13a)
14

Fig.3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15
10
10a(13a)
16
20
P2
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1k
23'
1j
24'
18a
T2
22
16a
B
18
12
1g

Fig.5

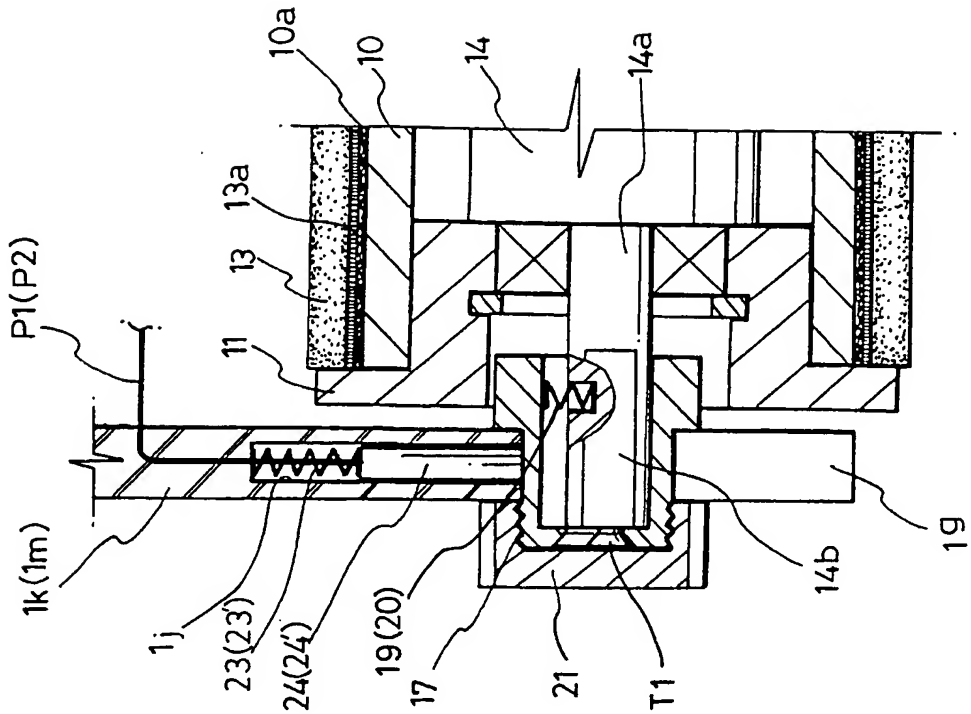

10a
10
14
14a
13a
13
P1(P2)
11
1k(1m)
1j
23(23')
24(24')
19(20)
17
21
T1
14b
19

Fig.4

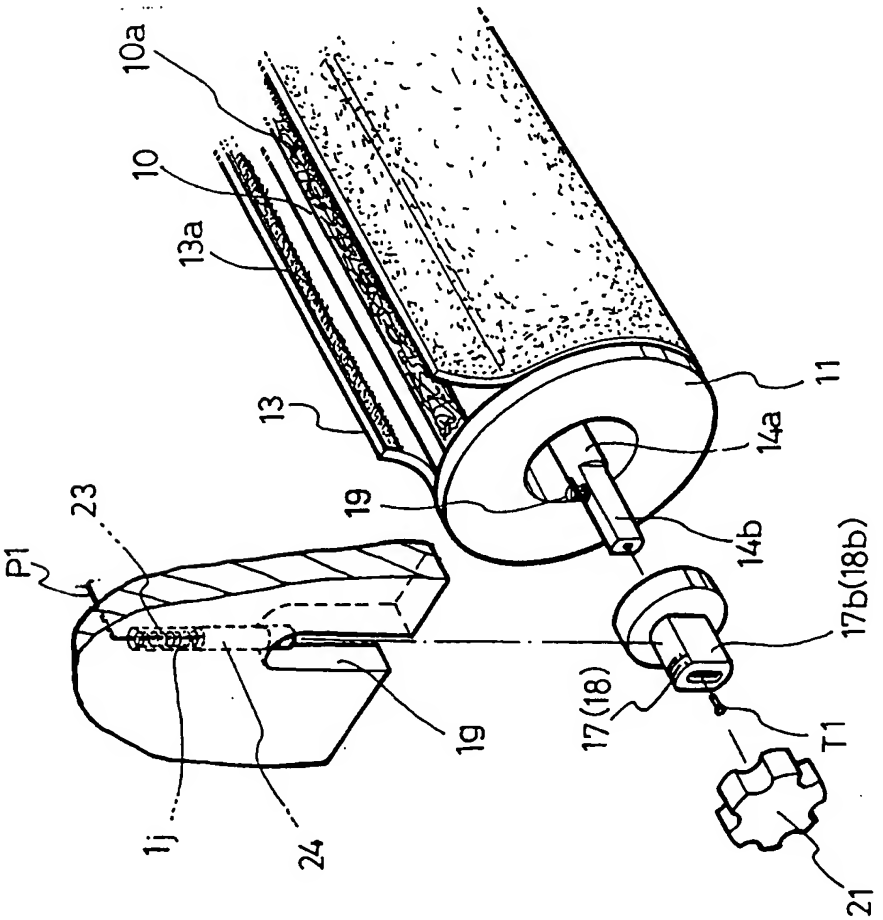
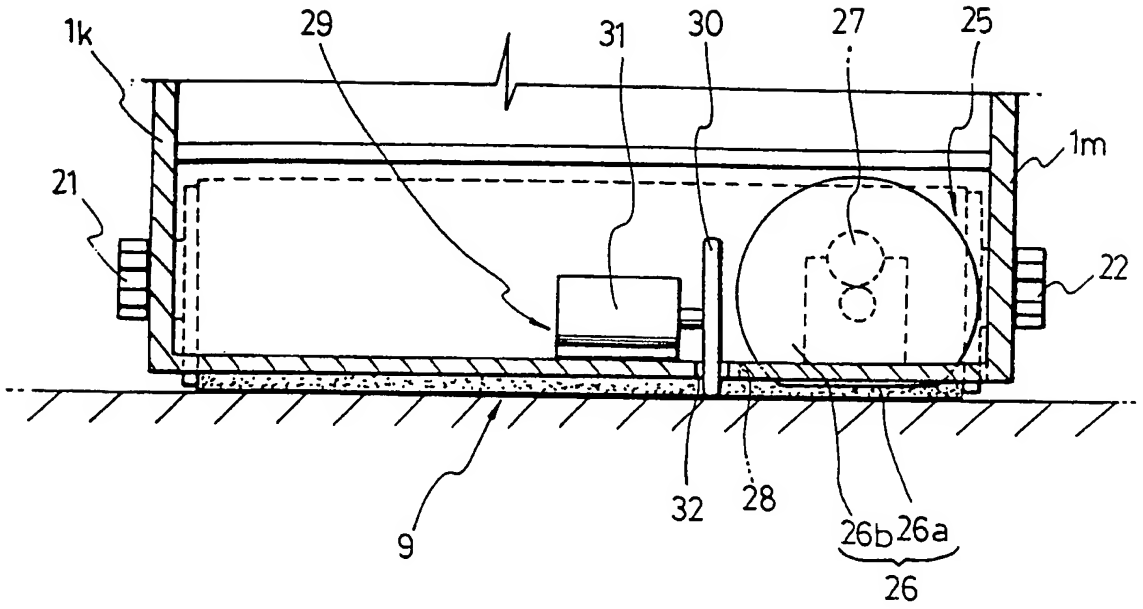

10a
10
13a
13
11
14a
19
23
P1
14b
17b(18b)
17(18)
T1
19
1j
24
21

Fig.6a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1m
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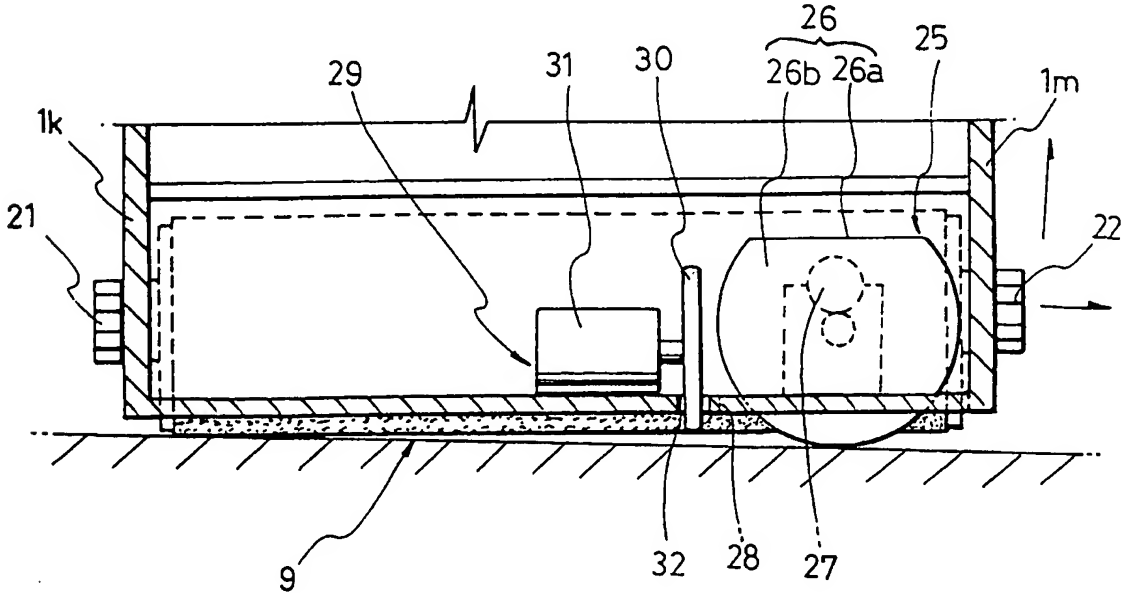
22
9
32
28
26b
26a
26

Fig.6b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1k
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27

Fig.7

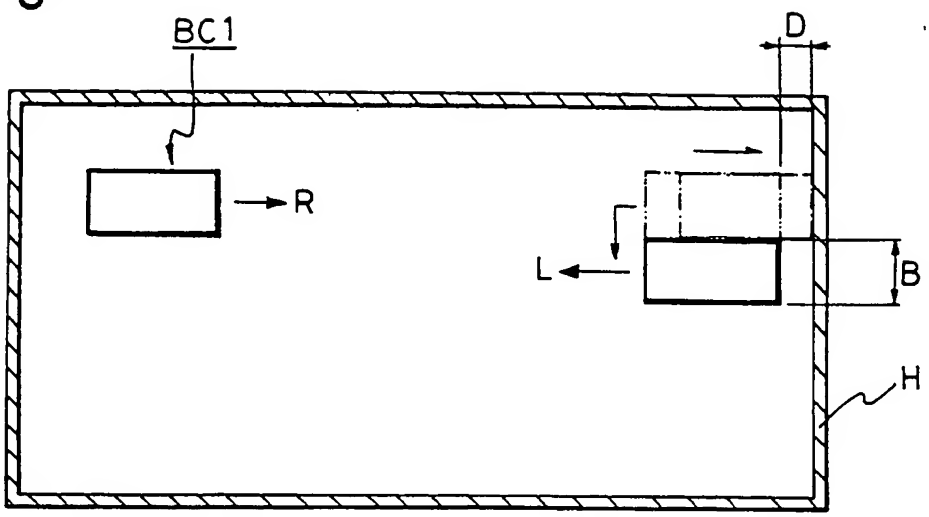


Fig.8

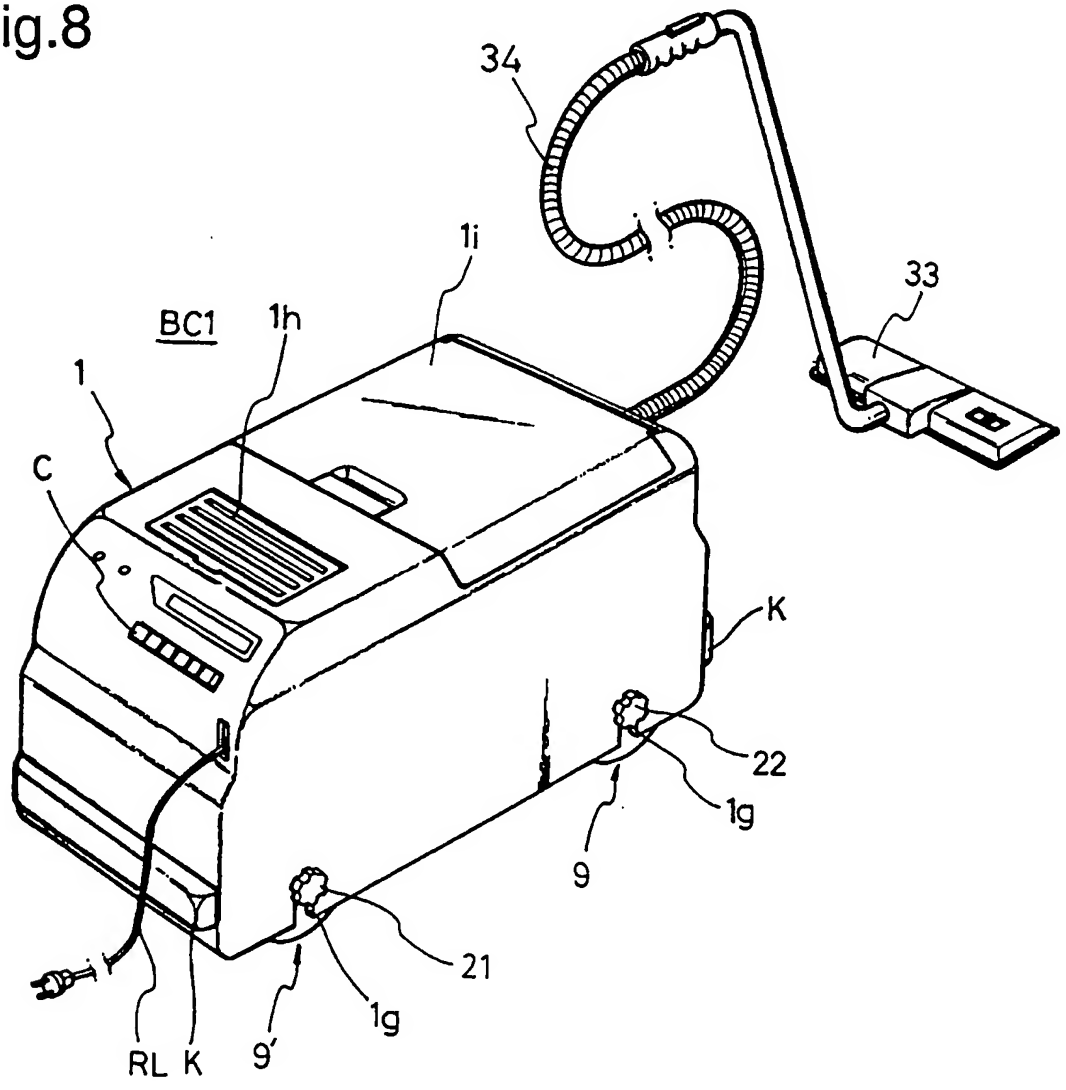


Fig.9

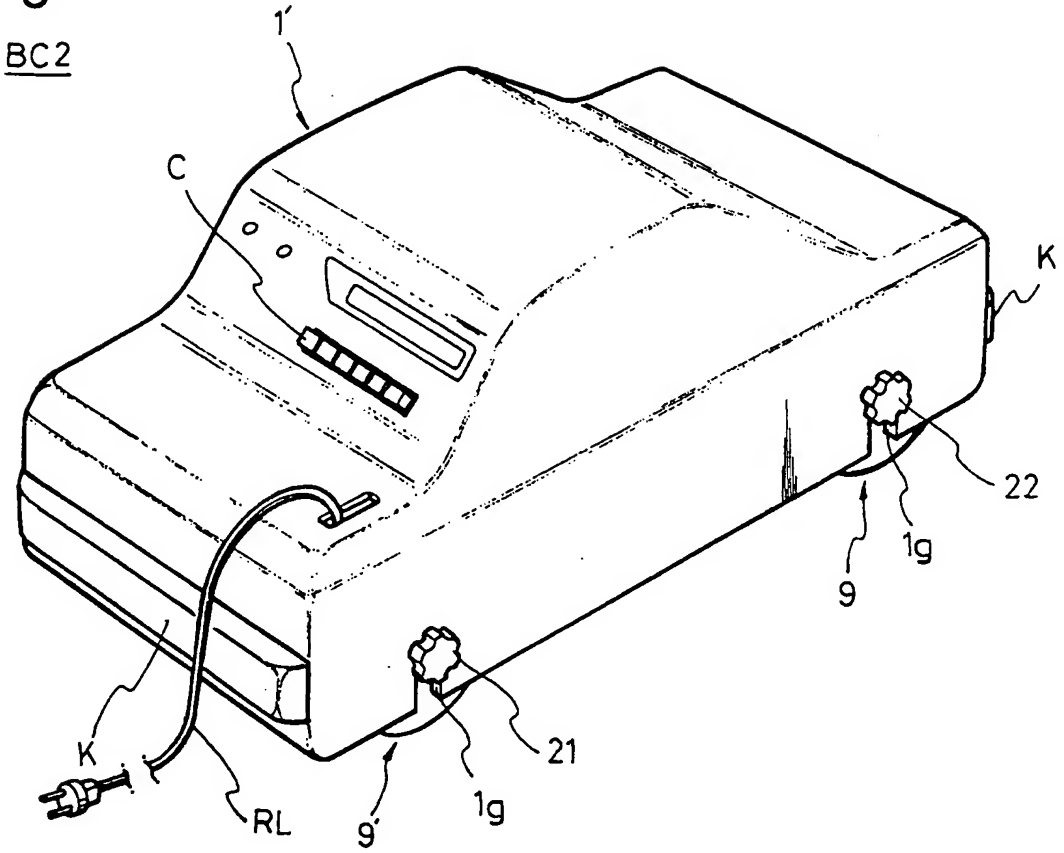
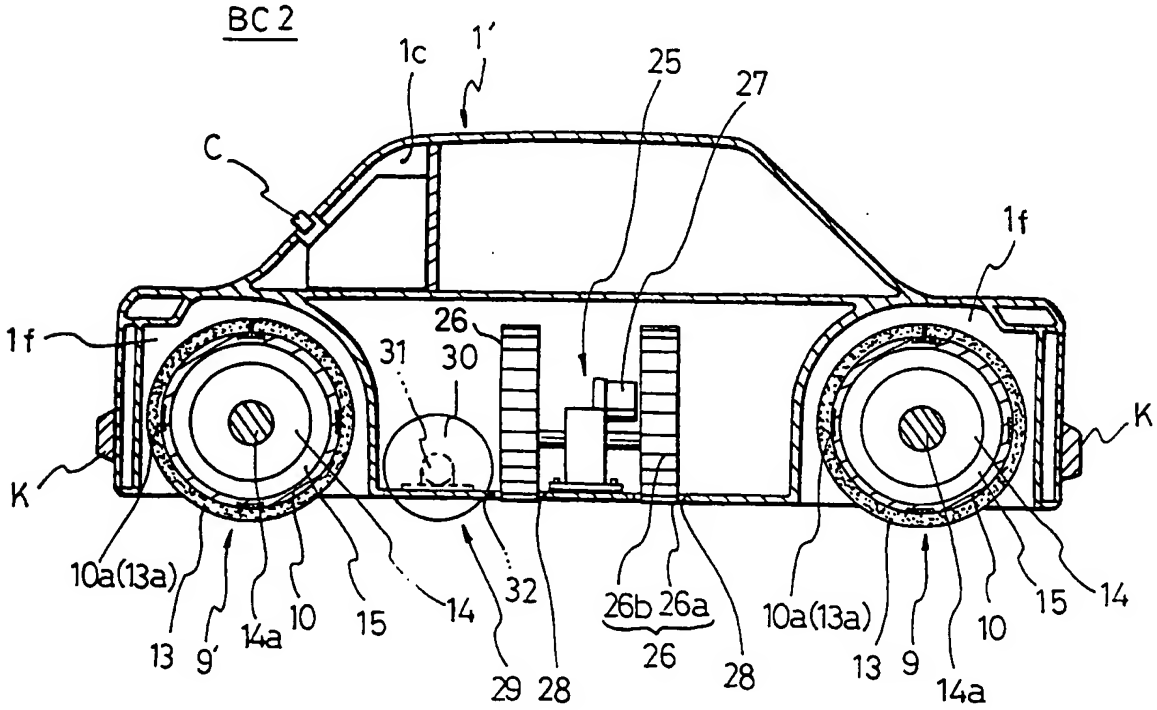

BC2
1'
C
K
22
1g
9
K
RL
9'
1g
21

Fig.10


BC 2
1c
1'
25
27
C
1f
1f
26
31
30
K
K
10a(13a)
13
9'
14a
10
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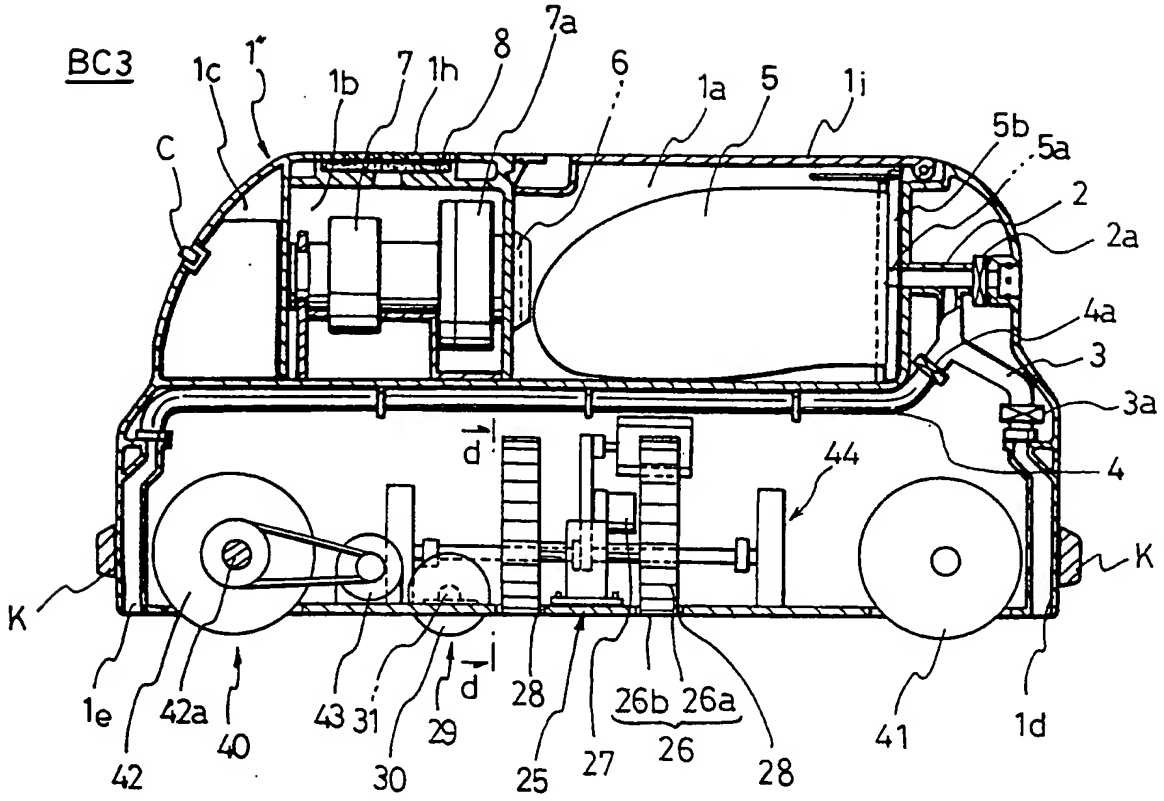
10a(13a)
13
9
14a
10
15
14

Fig.11


BC3
1c
1'
1b
7
1h
8
7a
6
1a
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1i
5b
5a
2
2a
C
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3
3a
4
44
K
K
d
d
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27
26b
26a
26
28
41
1d

Fig.12

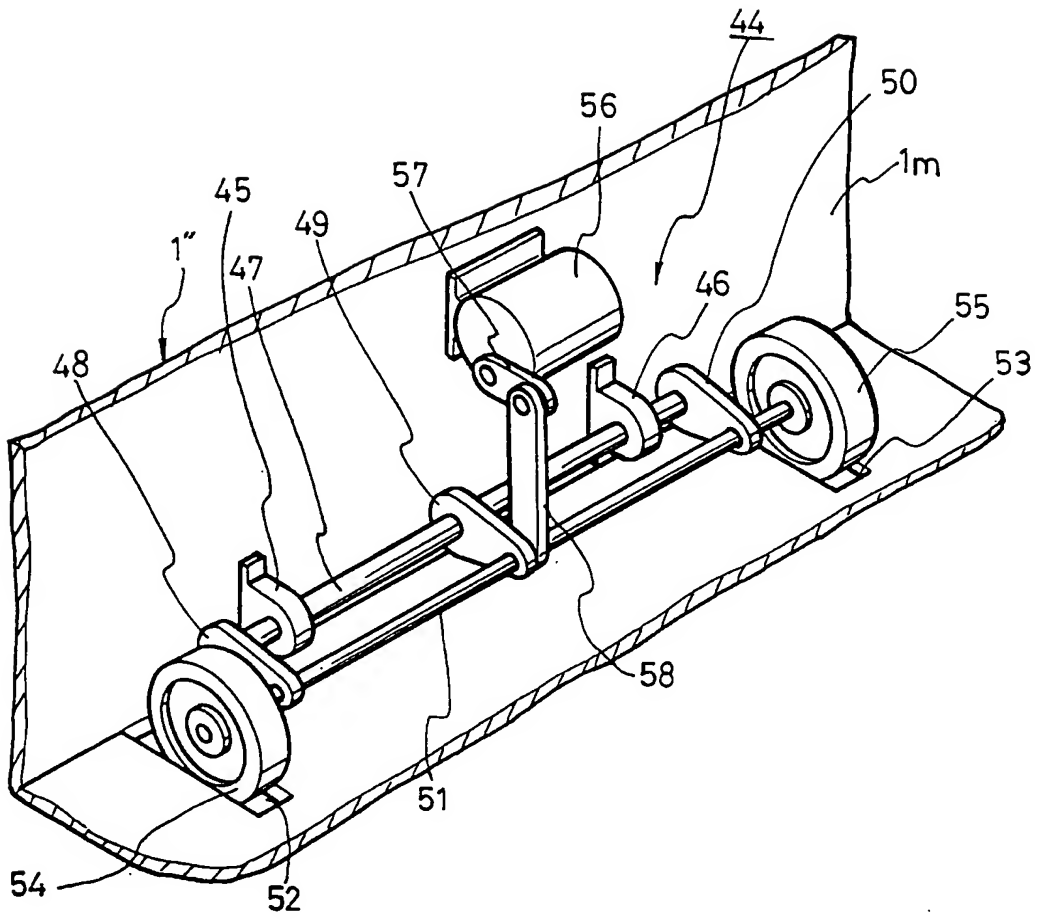


Fig.13a

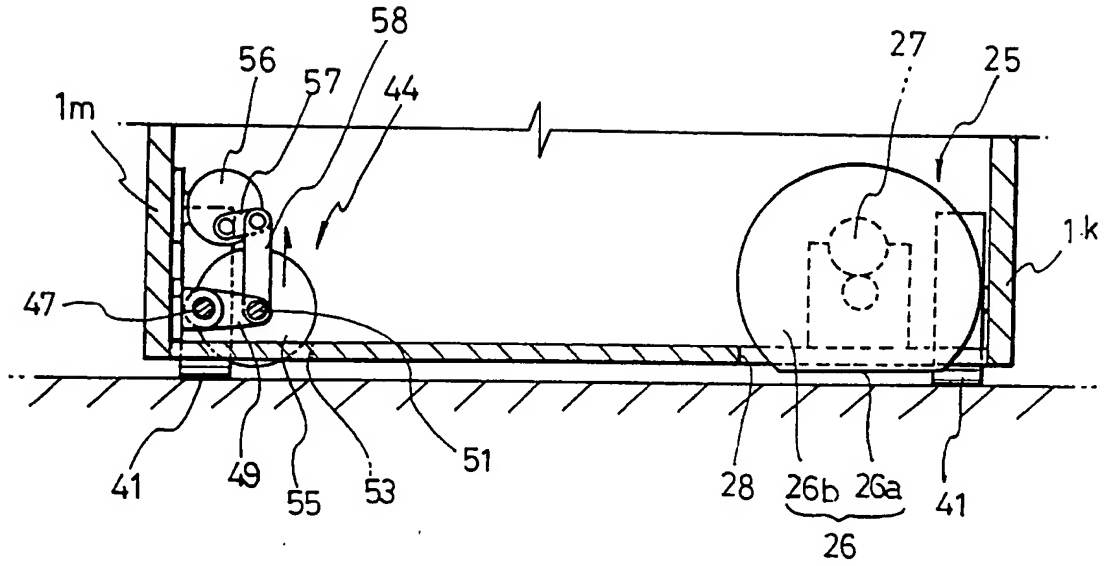


Fig.13b

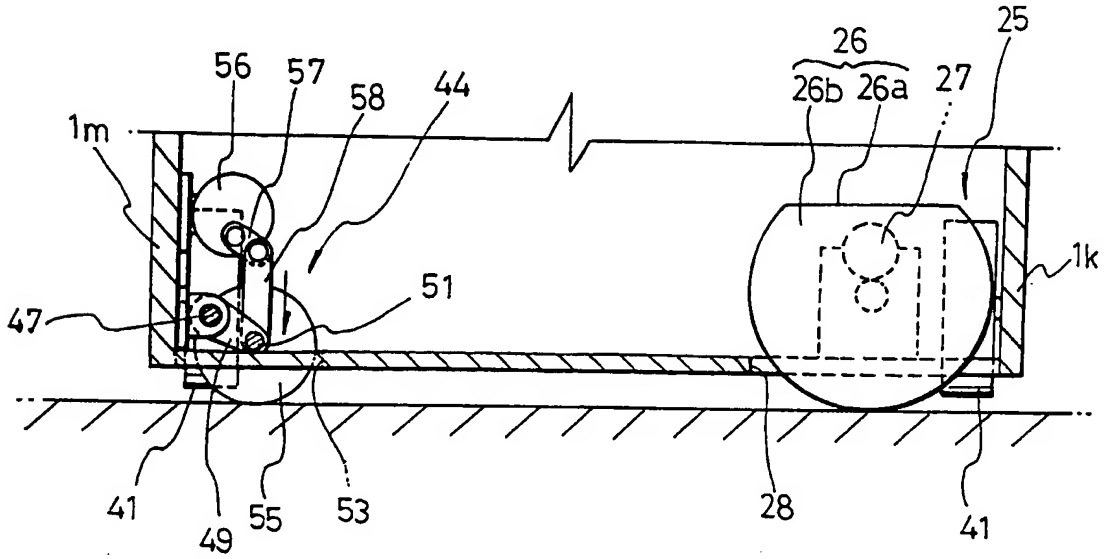


Fig.14

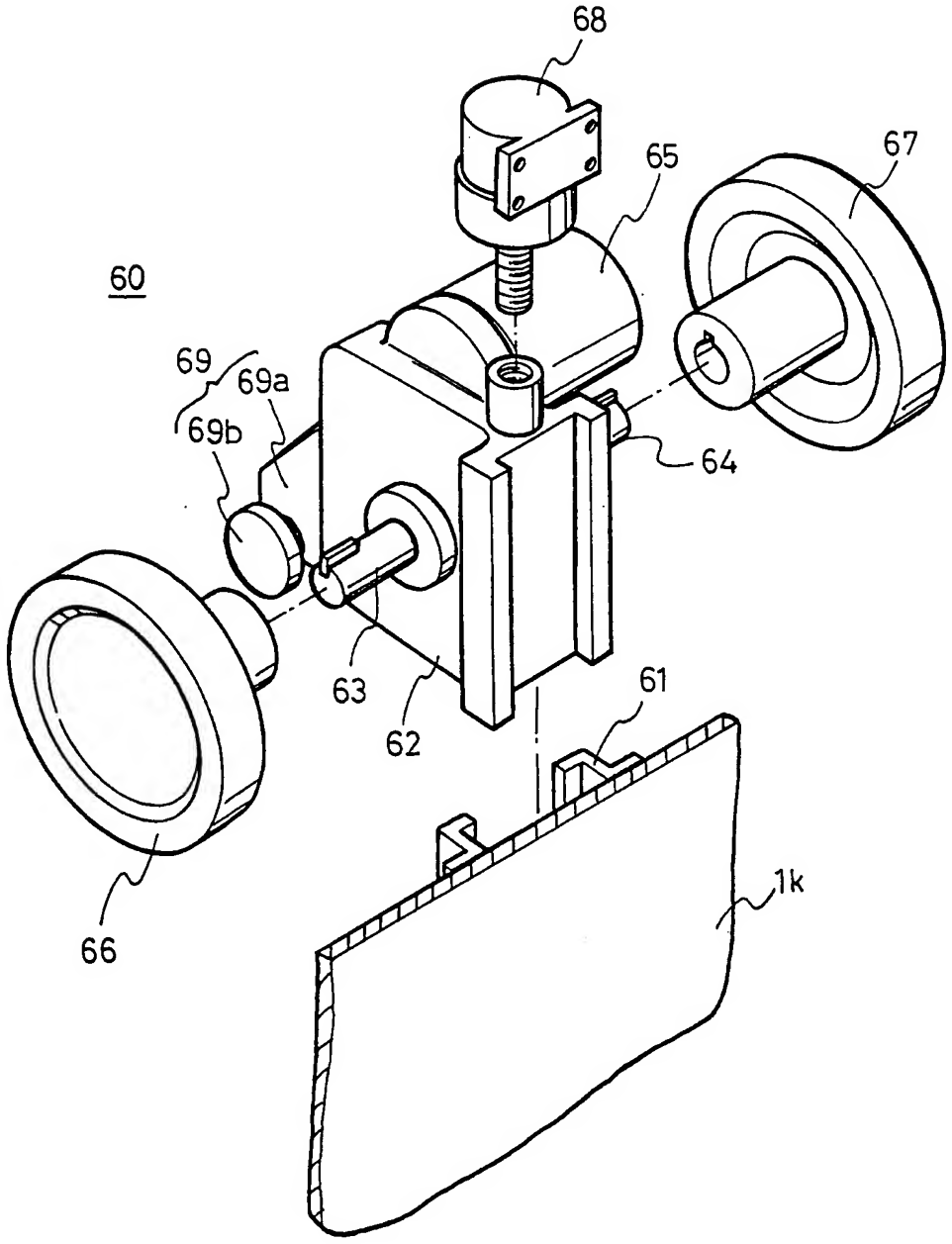


Fig.15a

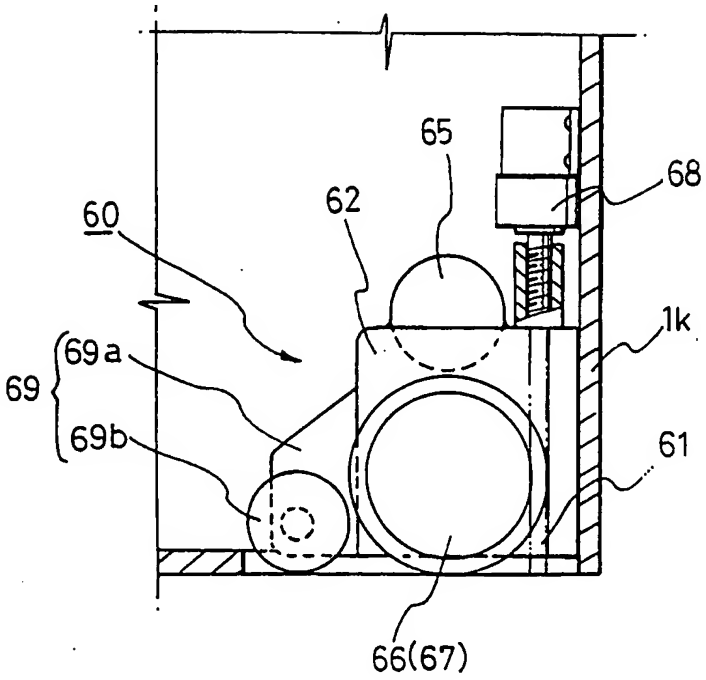


Fig.15b

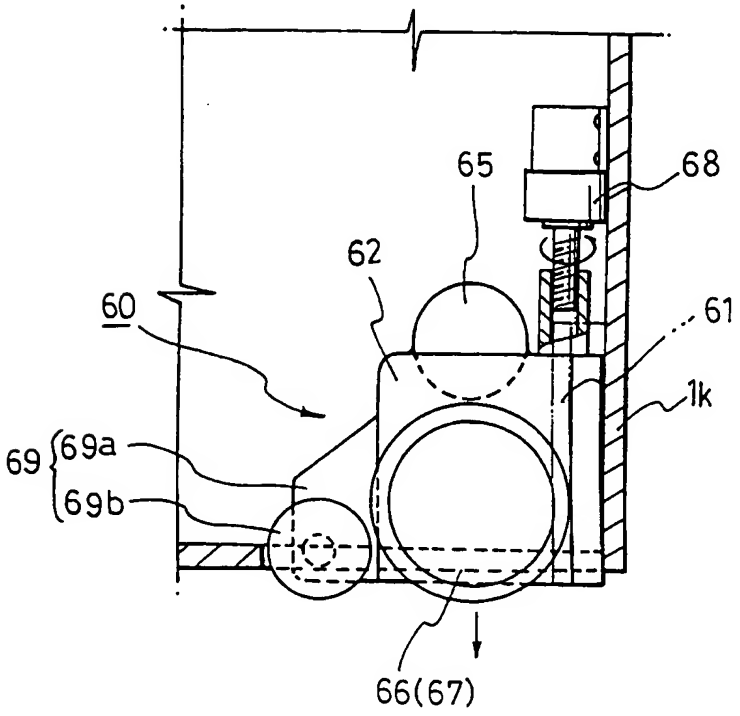
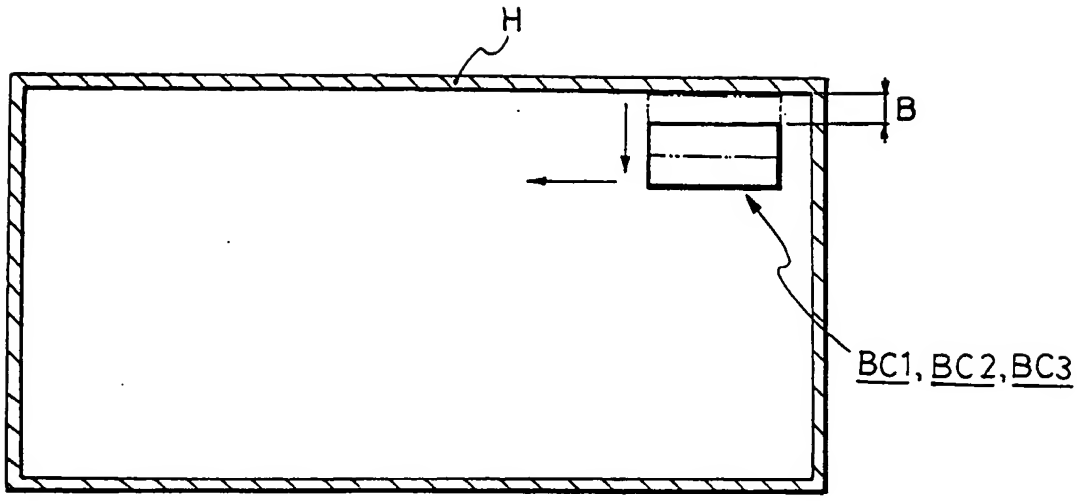


Fig.16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR99/00320

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7]: A 47 L 5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: A 47 L 5/00, 7/00, 9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5440216 A (KIM) 08 August 1995 (08.08.95), fig.1, fig.4, pos.6, 8, 14, 16, 18, 20, 23, 52, 58.	1, 5, 7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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„&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 February 2000 (16.02.00)	28 March 2000 (28.03.00)

Name and mailing adress of the ISA/AT	Authorized officer
Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/200	Baburek Telephone No. 1/53424/352

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 99/00320

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		GB A0 9323741	05-01-1994
		GB A1 2278937	14-12-1994
		GB A0 9716988	15-10-1997
		GB A0 9716989	15-10-1997
		GB A0 9716990	15-10-1997
		GB A1 2313190	19-11-1997
		GB A1 2313191	19-11-1997
		GB A1 2313213	19-11-1997
		GB B2 2313213	07-01-1998
		GB B2 2278937	14-01-1998
		GB B2 2313190	14-01-1998
		GB B2 2313191	14-01-1998
		JP A2 7008428	13-01-1995